THE ROYAL RULES

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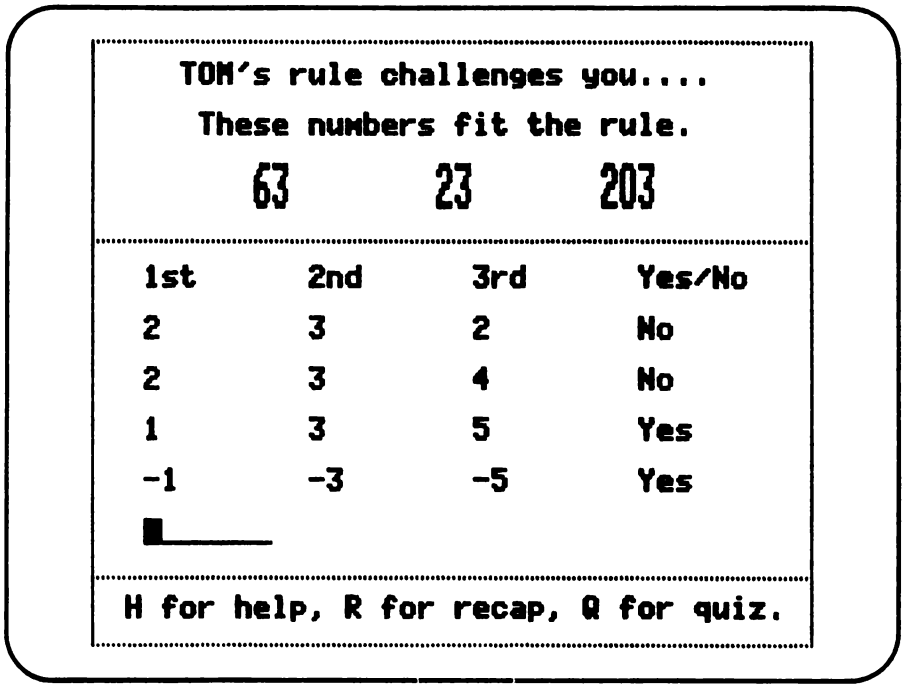
THE ROYAL RULES

Program Objectives


TOM's rule challenges you....
These numbers fit the rule.
63 23 203
1st 2nd 3rd Yes/No
2 3 2 No
2 3 4 No
1 3 5 Yes
-1 -3 -5 Yes
H for help, R for recap, Q for quiz.

Skills: Recognizing number patterns and relationships
Adding, subtracting, multiplying, and dividing
Forming and testing hypotheses
Problem solving
Developing and using complex classification strategies

Grade Level: 6 - adult

Reading Level: 4th grade (Fry)

Time Required: 10-20 minutes for each level

Objectives:
1. To enable players to form and test hypotheses.
2. To help players build skills in recognizing numerical patterns and relationships.
3. To help players develop skills in critical thinking and problem solving.

THE ROYAL RULES

Program Overview

The Royal Rules includes a Program Diskette and a Data Diskette. On the Program Diskette, players solve number problems--guessing the rules that apply to sets of three numbers--at four levels of difficulty. After they have discovered three rules on a chosen level, players are allowed to solve new rules or to enter rules of their own which are then saved onto the Data Diskette. The ultimate objective for players is to come face-to-face with the Queen, at which time each player is challenged to solve a final series of problems. To finish the game at this level may require many tries, even for a very able player.

The program has four levels of difficulty:

Level 1: The City
Level 2: The Duchy
Level 3: The Province
Level 4: The Kingdom

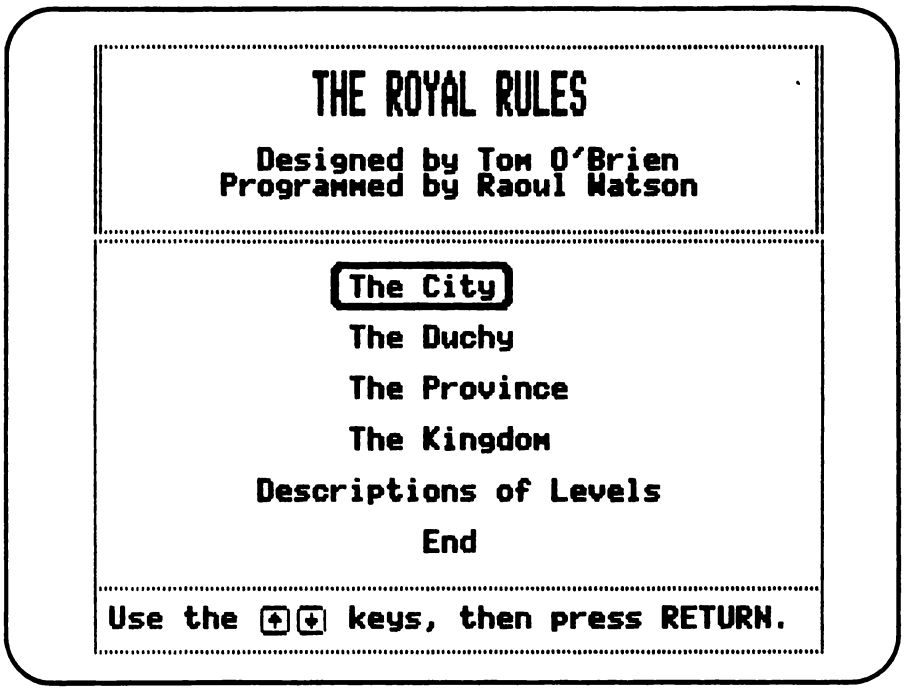
At each level, players can choose to play against the Sunburst Rules provided on the Program Diskette, the Player Rules entered on the Data Diskette by previous players, or a combination of both.

On each level, players are shown three numbers that correspond to a secret rule. They must generate their own hypotheses about the rule, and then test those hypotheses by entering their own sets of three numbers to be checked against the rule. Players will receive a "Yes" answer to those sets that conform to the rule, and a "No" answer to those that do not. When players feel confident that they know the rule, they can take a quiz that tests their hypothesis.

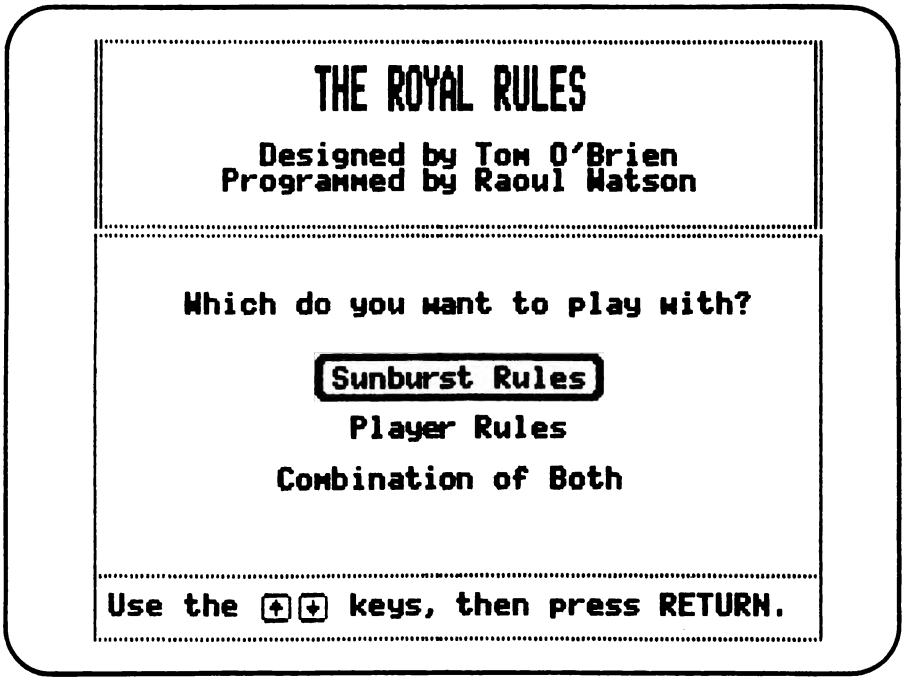
If players fail a quiz by answering any of its questions incorrectly, they may try the same rule again. They can also choose a new rule. But they cannot enter a rule of their own for others to play against until they have passed three quizzes on one level.

Starting the Program

Students start with the Program Diskette and choose a level from the main menu, as shown below:



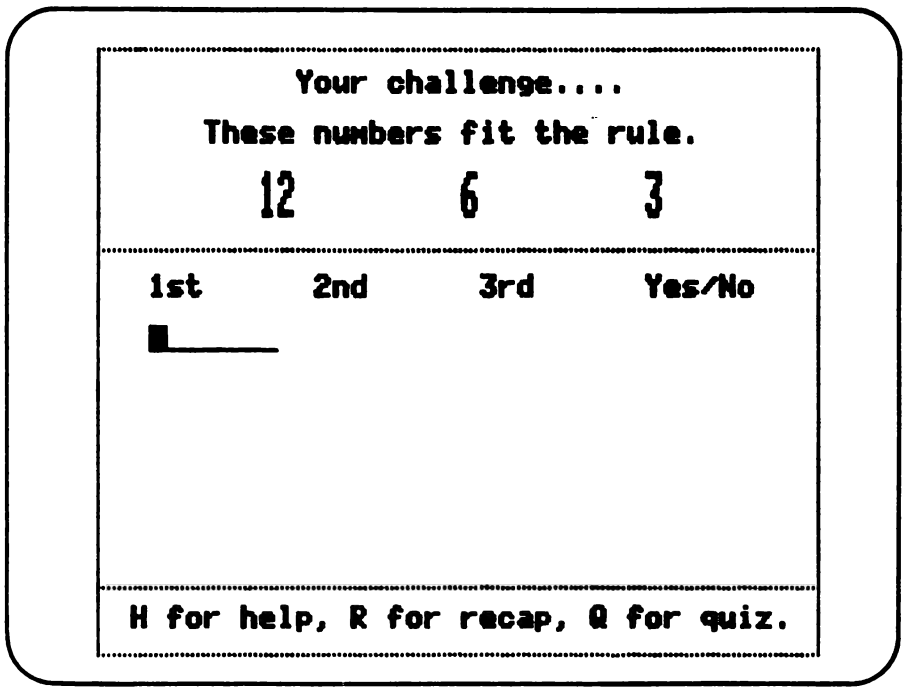
On each level, players can choose Sunburst Rules, Player Rules, or Combination of Both, as shown below:


THE ROYAL RULES
Designed by Tom O'Brien
Programmed by Raoul Watson
Which do you want to play with?
Sunburst Rules
Player Rules
Combination of Both
Use the ↑↓ keys, then press RETURN.

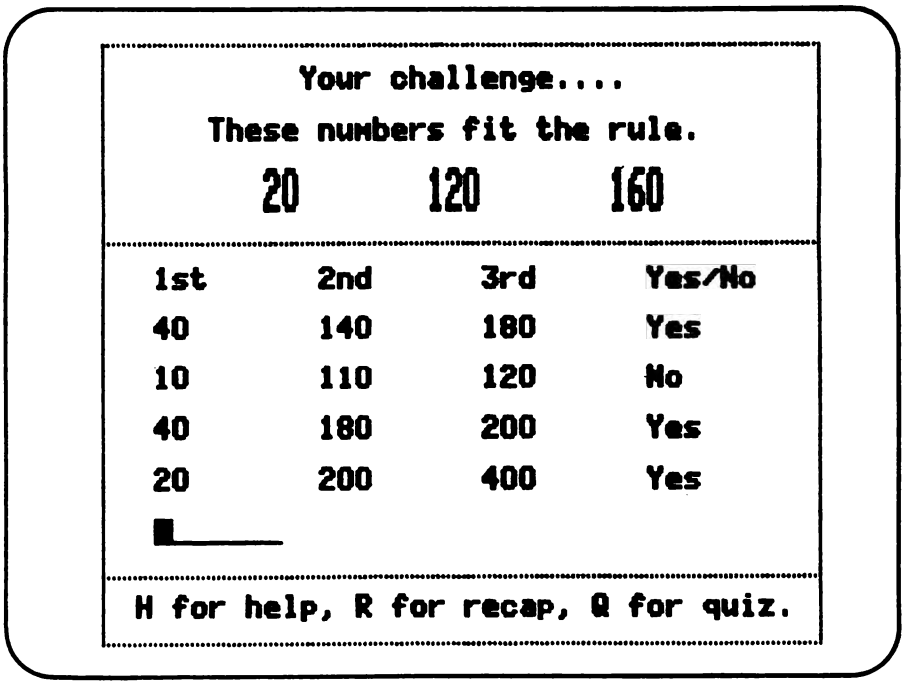
Players who select Player Rules or Combination of Both will need the Data Diskette. If the Data Diskette is empty (as when it is used for the first time), players will be informed that there are no Player Rules available.

Testing Hypotheses

On each level, players are shown three numbers corresponding to a secret rule, as in the following example:



Players must then generate their own hypotheses by entering their own sets of three numbers to be checked against the rule. They will receive a "Yes" answer to those sets that conform to the rule, and a "No" answer to those that do not, as in the following example:


Your challenge....
These numbers fit the rule.
20 120 160
1st 2nd 3rd Yes/No
40 140 180 Yes
10 110 120 No
40 180 200 Yes
20 200 400 Yes
H for help, R for recap, Q for quiz.

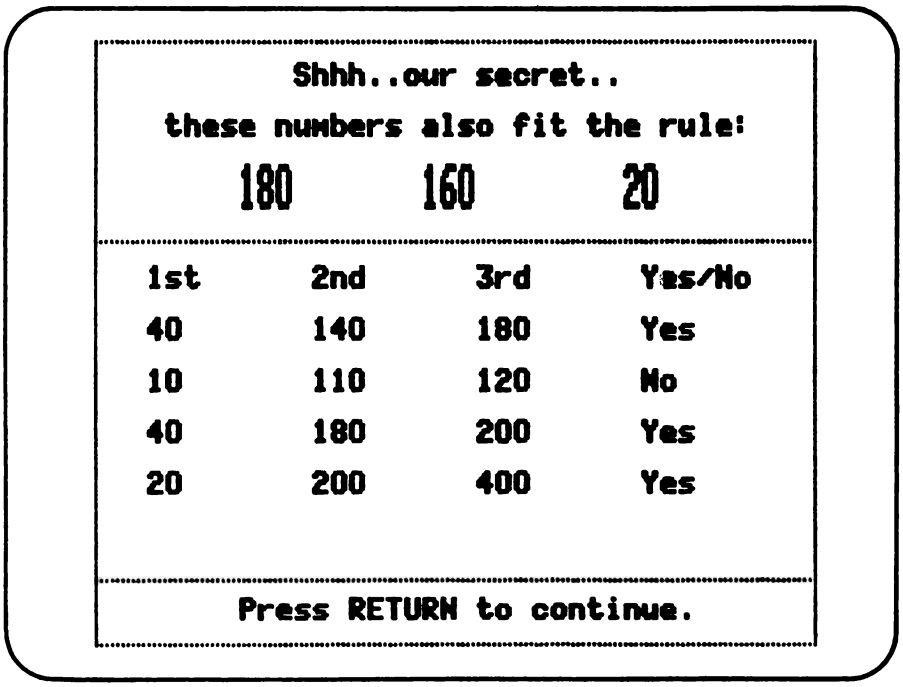
The goal is for players to test as many hypotheses as possible until they feel they know the rule and are ready to take a quiz.

Players can enter as many hypotheses as they wish. When they have filled the entire screen with their guesses, the first line is automatically deleted but not lost (see Recap below), allowing more entries at the bottom of the screen.

Player Options

At any time while testing their hypotheses, students can use the following options:

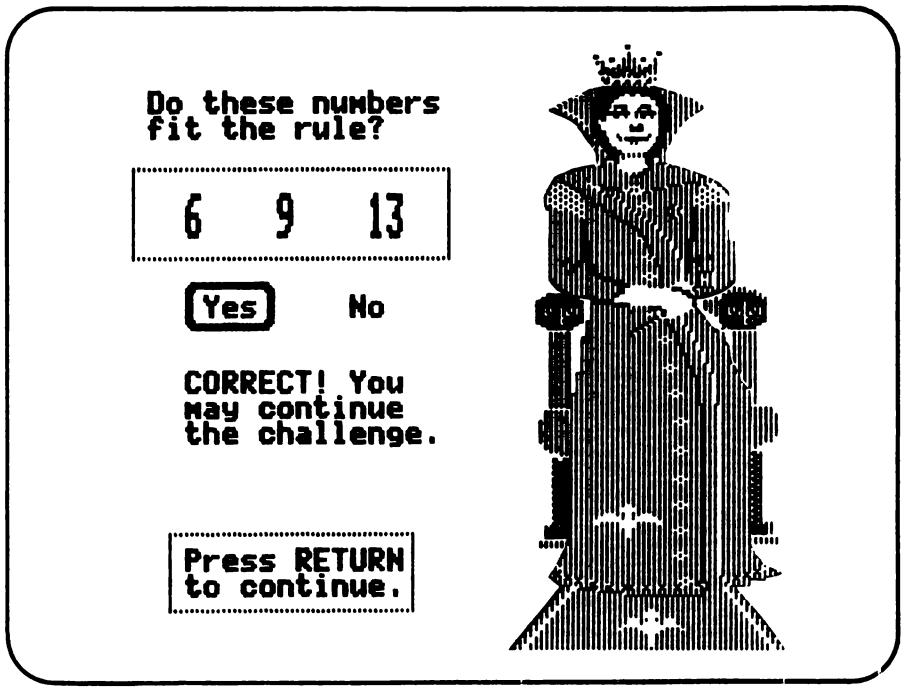
- Help - Players may press the H key to receive a new set of three numbers which also fit the rule, as in the following example:



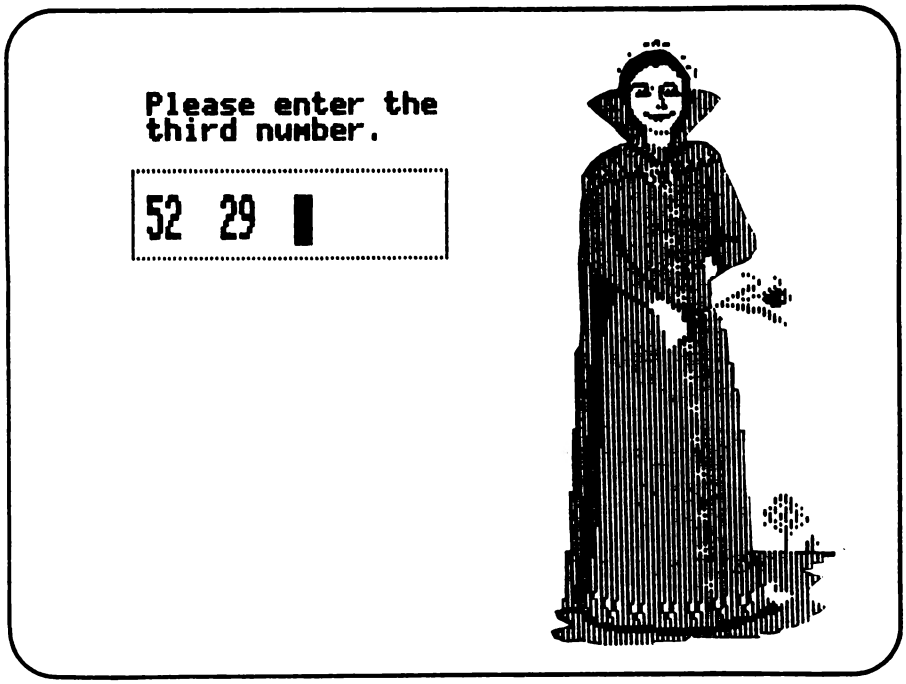
- Recap - Players who have entered more hypotheses than can fit on one screen may receive a recap of their previous guesses by pressing the R key at any number input.

- Quiz Request - Players can call for a quiz by pressing the Q key at any input during the hypothesis-testing activity. They will then be asked to answer five questions that will vary depending on the chosen level.

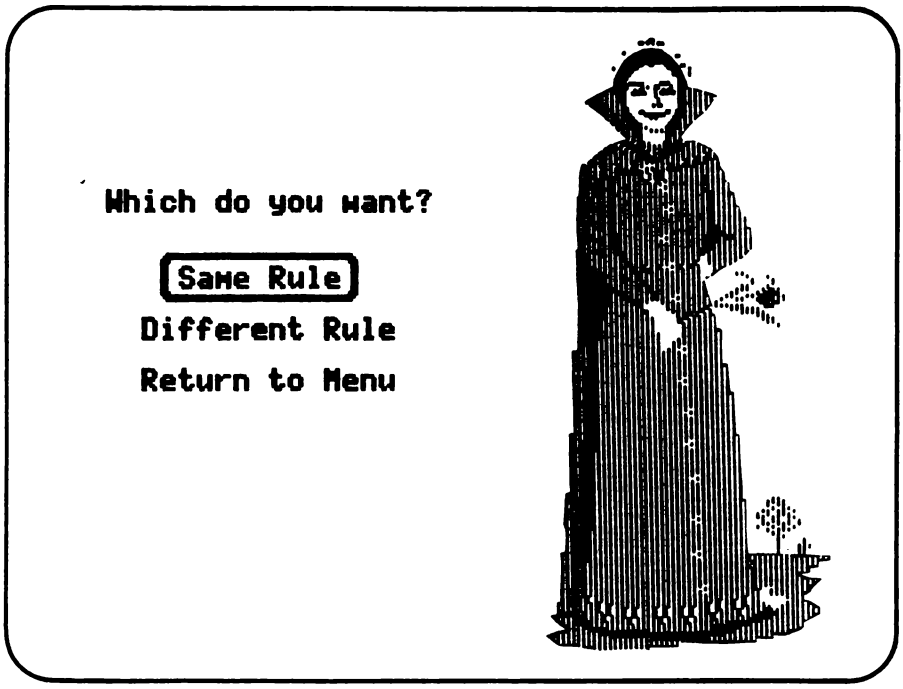
On levels 1 (The City), 3 (The Province), and 4 (The Kingdom), players are presented with five sets of three numbers, and they must state whether or not each set fits the rule, as in the following example:



On level 2 (The Duchy), players taking the quiz are given two numbers, they must supply a third number which will fit the rule, as shown below:



To complete a quiz successfully, players must answer each of the five questions correctly. Students who fail the quiz are given the following options:



Players who have passed the quiz are awarded an object which varies according to the chosen level. The objects displayed are the following:

Level 1: The City -- Magic Book
Level 2: The Duchy -- Royal Crest
Level 3: The Province -- Goblet
Level 4: The Kingdom -- Crown

Players who have passed three quizzes at any level are given the choice to enter their own rules (see Creating Rules page 19) provided the teacher has permitted this option (see Change Options page 27). Players who do not wish to enter their own rules are returned to the main menu. They can then select a different level and play the game again.

Exiting the Program

Players can exit the program at any time by holding down the CONTROL (CTRL) key and pressing the E key. If they choose to exit the game during the hypothesis-testing or the quiz activities of the program, they will be given the option to choose the same rules, to choose a different rule, or to return to the main menu.

Please Note: Students who have won one quiz and return to the main menu before completing the next two quizzes will lose that first quiz object.

THE ROYAL RULES

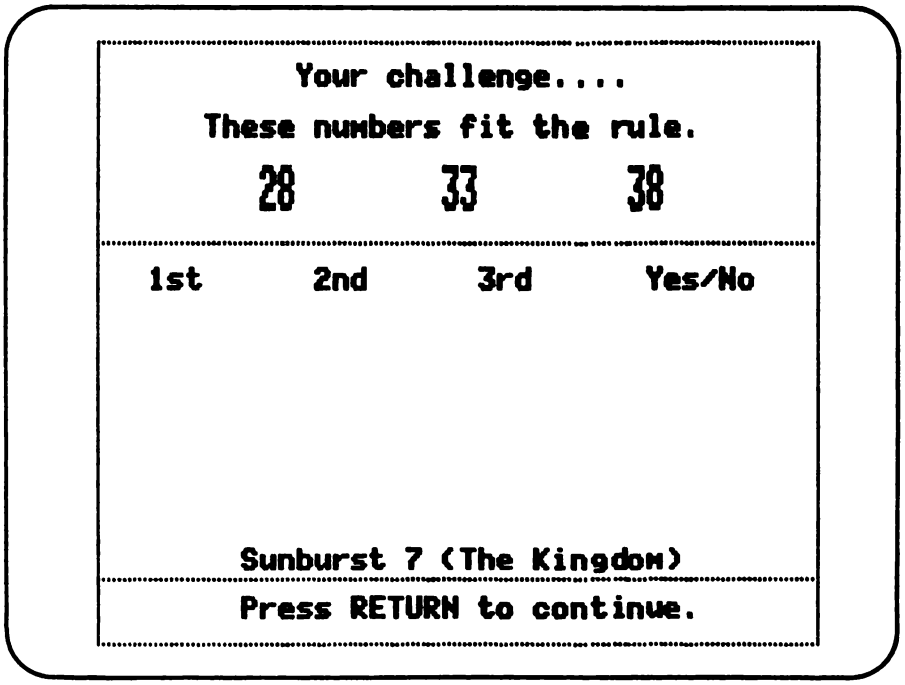
Difficulty Levels

Each difficulty level in this program offers students a different set of rules. This section of the guide contains a list of the rules for each level. Teachers will need to refer to this list whenever they wish to check the current rule under which the program is operating.

Rule Display

At any levels while players are generating and testing hypotheses, teachers may see the current rule under which the program is operating. They may do so by holding the CONTROL (CTRL) key and pressing the T key. A message will then be displayed as follows:

- If the current rule is a Sunburst Rule: The Sunburst Rule number is displayed as listed in this section of the guide for a particular level. The level is also displayed, as shown below:



- If the current rule is a Player Rule: The number of the player who entered the rule is displayed, followed by the level. To view the rule, teachers need to select View Rules through the Change Options (see pages 27-28).

THE ROYAL RULES

Following are the descriptions of the rules of each level of difficulty. Although players may enter the program at any level, they should all be encouraged to work through the first level. Sequential play is not so important on Levels 2, 3, and 4.

Level 1: The City

Rules in Level 1 are transparent. That is, the three numbers given at the start clearly suggest the rule that governs them.

If the rule is "upward jumps of 2," an example might be:

10 12 14

Another typical rule might also be "downward jumps of 2."

14 12 10

If the rule is "downward jumps of 5," the program might present the set:

29 24 19

Here is a list of the Sunburst Rules provided on the Program Diskette for Level 1:

1. Three perfect squares
2. All numbers are divisible by 20
3. All numbers end in 99
4. All numbers are odd
5. Numbers in ascending order
6. Upward jumps of 11
7. Downward jumps of 7
8. The second number is half of the first and the third number is half the second number
9. Upward jumps of 101
10. The third number equals the first number times the second

Here are the types of rules allowed when players formulate and add their own rules:

1. Ends in a particular number
2. Constant upward jumps
3. Constant downward jumps
4. Constant multiples
5. Constant divisor
6. Multiples
7. All numbers are even
8. All numbers are odd

Level 2: The Duchy

Level 2 calls for deep thinking. Here, the third number is the result of an operation--addition, subtraction, multiplication, or division--involving the first two numbers, and in some cases, a constant.

Sunburst Rule 1, for example, is "The third number is double the sum of the first two numbers," or:

$$2(A+B)=C$$

If A (randomly chosen) = 3, and B (randomly chosen) = 0, then C=6 and the number trio is:

3, 0, 6.

What is the third number for 1, 10, ( )? The answer is 22.
Does 1,1,5 fit the rule? No, it doesn't, but 1,1,4 does fit the rule.

Sunburst Rule 2 is:

$$(A+B)^2=C$$

The number trio 0,0,0 fits the rule, and so does 1,5,36.
Does 4,1,2 fit the rule? No, but 4,1,25 does because:

$$(4+1)^2=25$$

Some of the rules displayed in this guide include the terms INT and MOD. INT is used to mean integer part, in other words, "ignore fractional parts" (for example: INT 4.3=4 and INT 7/2=3); MOD is used to mean "the remainder of a division" (for example: 29 MOD 3=2).

Here are the Sunburst Rules for Level 2:

1. $2(A+B)=C$
2. $(A+B)^2=C$
3. $(A-B)^2=C$
4. $(A)(B)(10)=C$
5. $INT((A+B)/2)=C$
6. $A^2-B=C$
7. $7A+B=C$
8. $INT(A/B)=C$
9. $A \text{ MOD } B = C$
10. $A^2+B^2=C$

The Player Rules for Level 2 are based on the formula:

AX+BY+K=C

For example, a possible rule may be "The third number is twice the first number plus twice the second number, plus three," or:

2A+2B+3=C
if A=5, and B=0,
then (2x5)+(2x0)+3=13.

Consequently, the number trio is: 5,0,13.
And what about 1,4,2? Does it fit the rule? No, it doesn't.
But 1,4,13 does fit the rule because:

(2x1)+(2x4)+3=13.

In the Player Rules for The Duchy (Level 2), the following formats are available:

1. A + B + K = C
2. A - B - K = C
3. A + B - K = C
4. A - B + K = C
5. AX + BY + K = C
6. AX - BY - K = C
7. AX + BY - K = C
8. AX - BY + K = C

After selecting a format (such as AX + BY + K = C), players are asked to choose a multiplier for the first number A, a multiplier for the second number B, and a constant, K. In each case, the choices range from -10 to 10. Suppose a player chooses, respectively, 0, 0, and 3. Then the rule is 0 times the first number, plus 0 times the second number, plus 3. The trios 4,5,3, or 9,24,3, and 7,1,3 all fit the rule, but 1,1,4 does not. If the constant K is not desired, one simply can enter 0. Zero can also be used for the multipliers X and Y.

Level 3: The Province

Level 3 differs from previous levels in that the example trios may disguise the rules they represent. Therefore, it is especially important to test several different hypotheses. If the student is presented with the set 100,200,300, the rule may not be as simple as it first appears. Rather than the obvious "multiples of 100" or "jumps of 100," the rule may be more subtle, such as "multiples of 2" or "multiples of 5."

If a player chooses a rule such as "multiples" (and other such rules needing further information), a follow-up question asks for the specific information, for example: "multiples of __," which the player must fill in with a number.

Suppose the example set, 100,200,300, represents the latter rule, "multiples of 5." Many players are likely to assume that the rule could be "multiples of 100," and may start the testing process by submitting other multiples of 100, such as 300,400,900. Since these numbers are also multiples of 5, the test sets do fit the rule. When presented with the quiz, players might then be asked to approve or reject the numbers 100,200,45. They might think that those numbers are not multiples of 100, and accordingly reject the set. Such an answer would be incorrect, and the players would fail the quiz. A better strategy would have been to test the rules "multiples of 10," "multiples of 5," and "multiples of 2," and others. In Level 3, players must be constantly on guard against being misled by the examples disguised.

Following are the disguised examples provided on the Program Diskette, and the actual Sunburst Rule each represents:

1. Disguise: Constant upward jumps
   Rule: Any constant upward OR downward jumps

2. Disguise: Upward jumps of n (n divisible by 3)
   Rule: Constant upward or downward jumps which are divisible by 3

3. Disguise: Constant upward or downward jumps
   Rule: The second number = (the first + the third) divided by 2

4. Disguise: Three consecutive numbers
   Rule: Any constant jumps

5. Disguise: The third number equals the first times the second
   Rule: The third number is divisible by BOTH the first and second

6. Disguise: The third number equals the first plus the second
   Rule: The third number equals the first plus the second

7. Disguise: Upward jumps of 2
   Rule: All even numbers OR all odd numbers

8. Disguise: The third number equals the first times the second
   Rule: The third number is divisible by the first

9. Disguise: Multiples of 100
   Rule: Multiples of 5

10. Disguise: Constant upward jumps
    Rule: The difference of the first number and the third is even

THE ROYAL RULES

Listed below are the types of rules allowed when teachers and players formulate their own rules for Level 3:

1. Ends in a particular digit
2. Constant upward jumps
3. Constant downward jumps
4. Constant multiples
5. Constant divisor
6. Multiples
7. All numbers are even
8. All numbers are odd
9. Ascending numbers
10. Descending numbers

The same list is given both for the rule and for the disguise. Players may choose to create a rule first or a disguise first (see Creating Rules page 19). Even though the list is the same for rules and disguises, the match-ups are incredibly rich and complex. Here are some possible situations teachers and players can construct:

Disguise: Ends in 1
Rule: All numbers are odd

Disguise: Ends in 0
Rule: Multiples of 2

Disguise: Multiples of 8
Rule: Multiples of 1

Disguise: Constant multiples of 5 (for example, 2,10,50)
Rule: Ascending numbers

Disguise: Multiples of 9
Rule: Multiples of 3

Level 4: The Kingdom

Level 4 uses very simple rules, but is extremely challenging because the rules may apply to only one, at least one, or all three of the numbers presented. For example, the program may present 64,66,68 and the rule could be "At least one number is a perfect square."

THE ROYAL RULES

Following are "disguised" examples given by the Sunburst program, and the actual rule each represents:

1. Disguise: Upward jumps of n
   Rule: Numbers in ascending order

2. Disguise: Multiples of 100
   Rule: Multiples of 4

3. Disguise: Multiples of 100
   Rule: The sum of the numbers is divisible by 4

4. Disguise: Three ascending squares
   Rule: All numbers are squares

5. Disguise: Constant upward jumps
   Rule: The first number is the smallest

6. Disguise: Three multiples of n
   Rule: At least one number is a multiple of n

7. Disguise: Upward jumps of n (n is odd)
   Rule: At least one number is even

8. Disguise: Three consecutive even numbers
   Rule: Ascending OR descending numbers

9. Disguise: Three numbers greater than one where the third number equals the first times the second
   Rule: The third number is the largest

10. Disguise: Three positive numbers where the third number is the first minus the second
    Rule: The first number is the largest

In constructing Player Rules (and disguises) for Level 4, teachers and players are asked whether they want their rule to apply to:

All of the numbers
At least one of the numbers
Only one of the numbers.

They are then asked for a disguise and a rule. For rules involving only one of the numbers, no disguise is used as the situations are difficult enough as presented.

If the rule applies to all of the numbers, the rule and the disguise are chosen from the following list:

1. Ends in a particular digit
2. Constant upward jumps
3. Constant downward jumps
4. Constant multiples
5. Constant divisor
6. Multiples
7. All numbers are even
8. All numbers are odd
9. Ascending numbers
10. Descending numbers
11. Consecutive even numbers
12. Consecutive odd numbers

If the rule applies to at least one of the numbers, the choices listed above are available for disguises, while the choices listed below are available for rules:

1. Ends in digit
2. Multiple
3. Odd number
4. Even number
5. Square

And if the rule applies to only one of the numbers, the rule must be selected from the following choices:

1. Ends in digit
2. Multiple
3. Odd number
4. Even number
5. Square
6. Smallest
7. Largest

In this manner, a wealth of situations can be created, as shown in the following examples:

Disguise: Consecutive even numbers
Rule: Multiples of 2

Disguise: Constant upward jumps of 1
Rule: At least one number is odd

Disguise: Ends in 0
Rule: At least one number is even

Disguise: Constant downward jumps of 2
Rule: Descending numbers

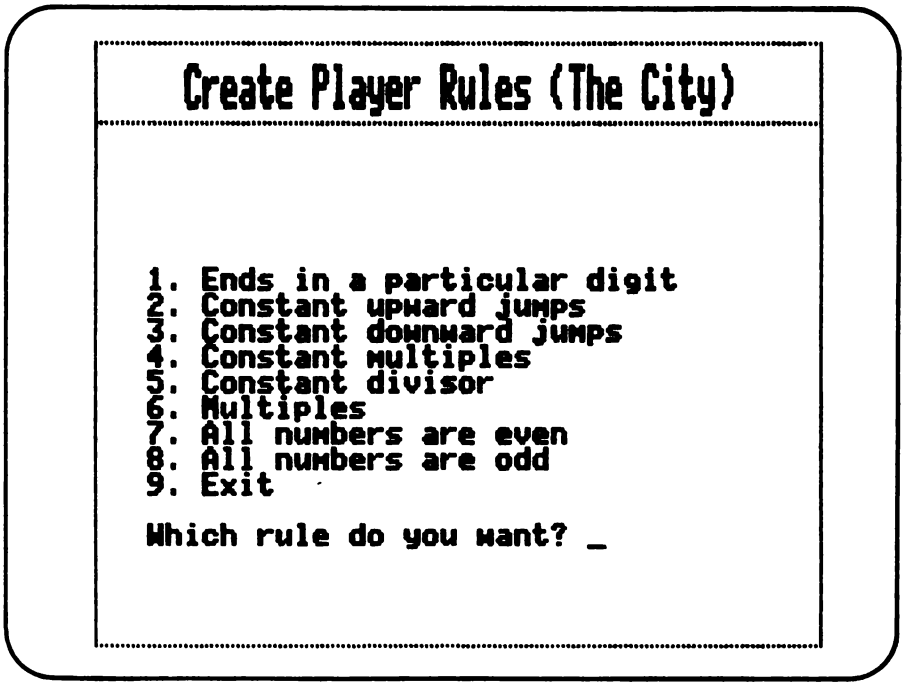
Disguise: (Not necessary since the rule pertains to only one number)
Rule: Third number is a square

Creating Rules

Teachers can enter rules through the Change Options (see page 29). Through the Change Options, teachers can also allow students to enter their own rules (see Rule Option page 27).

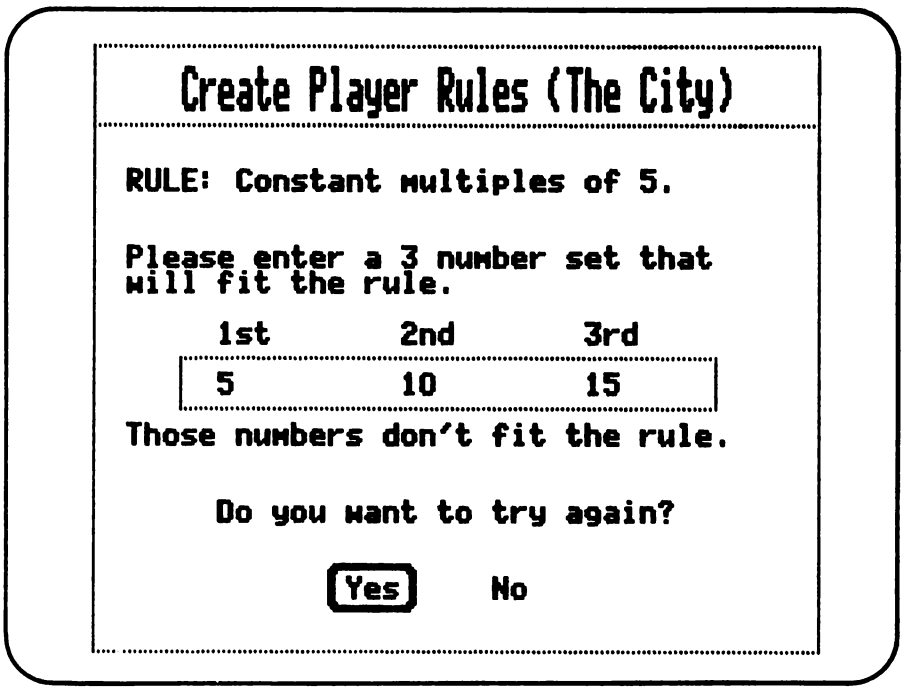
When teachers or players add a rule of their own, the rule is saved on the Data Diskette so that others may play against it. If one disk drive is used, a message will be displayed whenever the diskettes must be exchanged. If a two-disk drive system is used, the computer will automatically switch back and forth between the two diskettes.

On Level 1, teachers or players are prompted for a rule by choosing from a list of available rules as shown below.

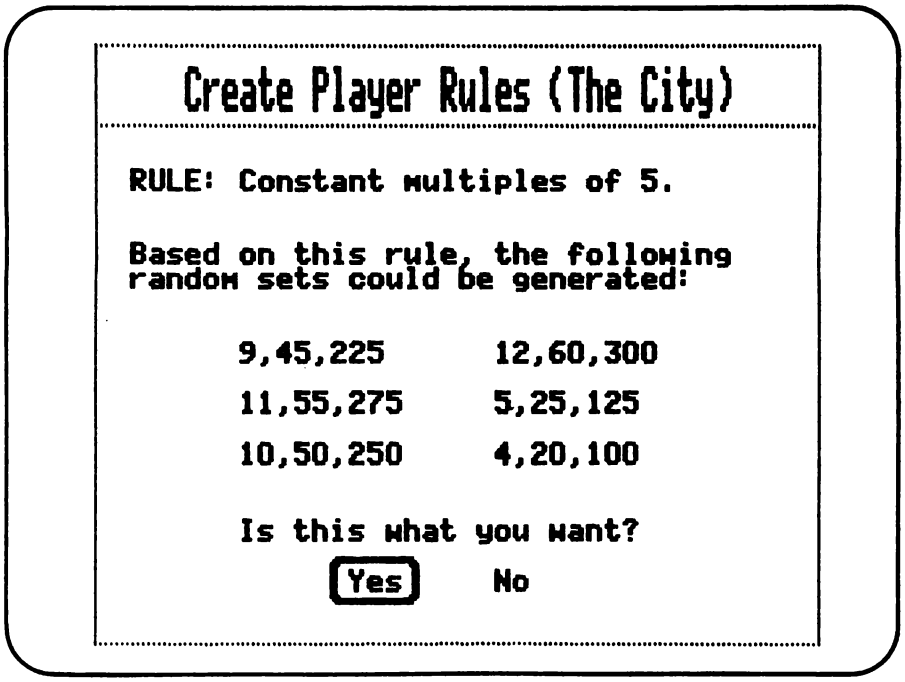

Create Player Rules (The City)
1. Ends in a particular digit
2. Constant upward jumps
3. Constant downward jumps
4. Constant multiples
5. Constant divisor
6. Multiples
7. All numbers are even
8. All numbers are odd
9. Exit
Which rule do you want? _

In some cases (for example, constant multiples), players are asked to choose a number within a given range of numbers.

Finally, the player must enter a sample trio depicting the rule. If the sample does not fit the rule, the teachers or players are given the chance to try again, as in the following example:



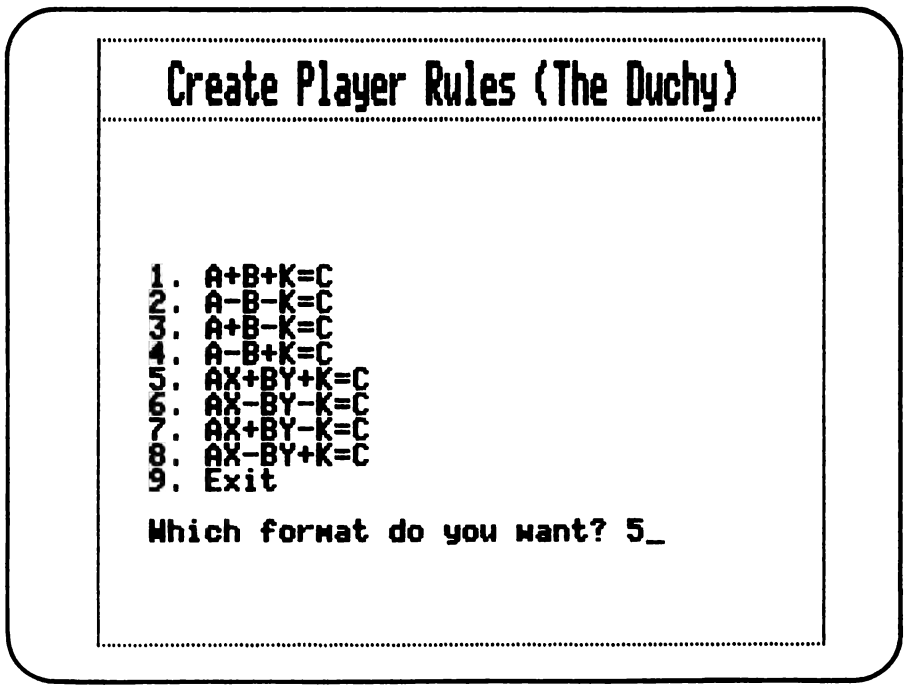
After a correct set of numbers has been entered, teachers or players are shown a list of possible sets which fit the rule. They are then asked whether they are satisfied with the results displayed, as in the example shown below:



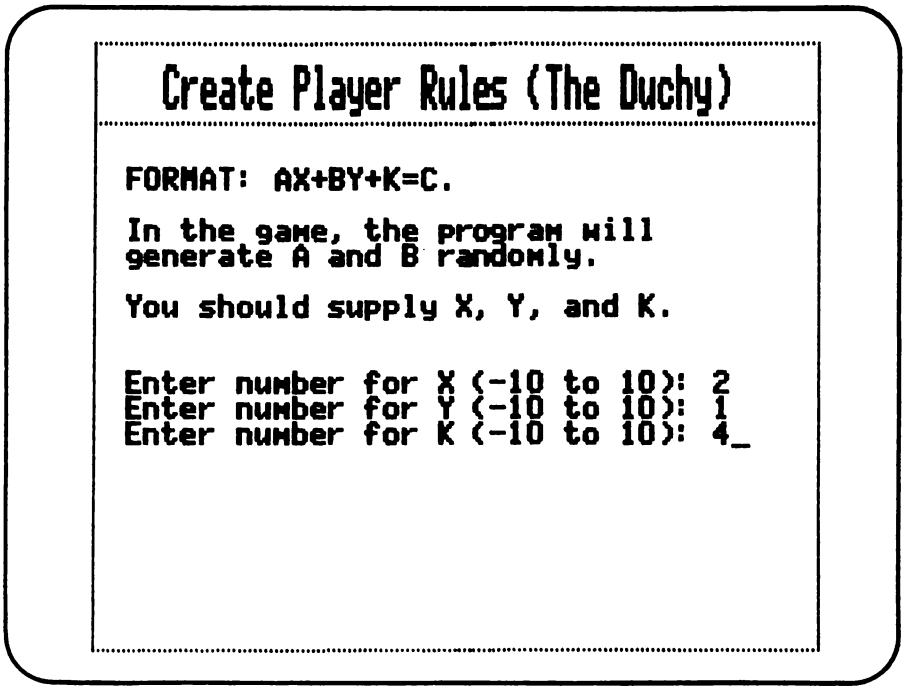
If they are not satisfied with the results, they get another chance at entering a rule. Once a player is satisfied with the rule, his or her name is requested and the rule is saved under that name on the Data Diskette. Players or teachers then have the option of entering another rule or returning to the menu.

Players and teachers can enter as many rules as desired. To do so, players must first pass three quizzes, while teachers can choose Create Player Rules from the Change Option menu (see Change Options page 27). It is possible for one player to fill an entire Data Diskette with rules for others to play against.

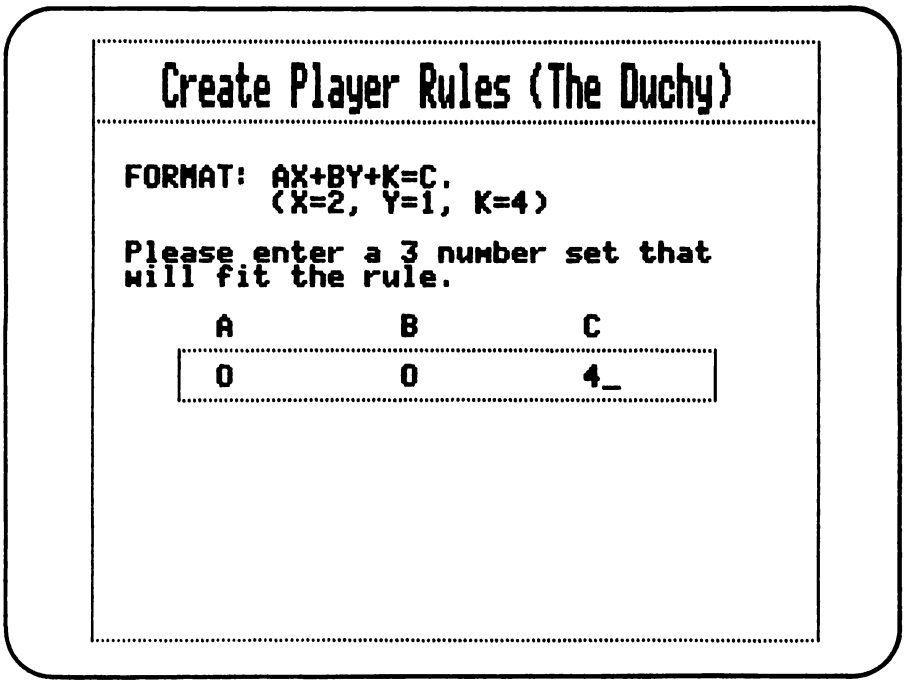
On Level 2, the same procedure as on Level 1 is used to enter rules, but the format chosen to define the rule is different, as shown below:



Players or teachers must define X,Y,K, as the program will generate A and B randomly:

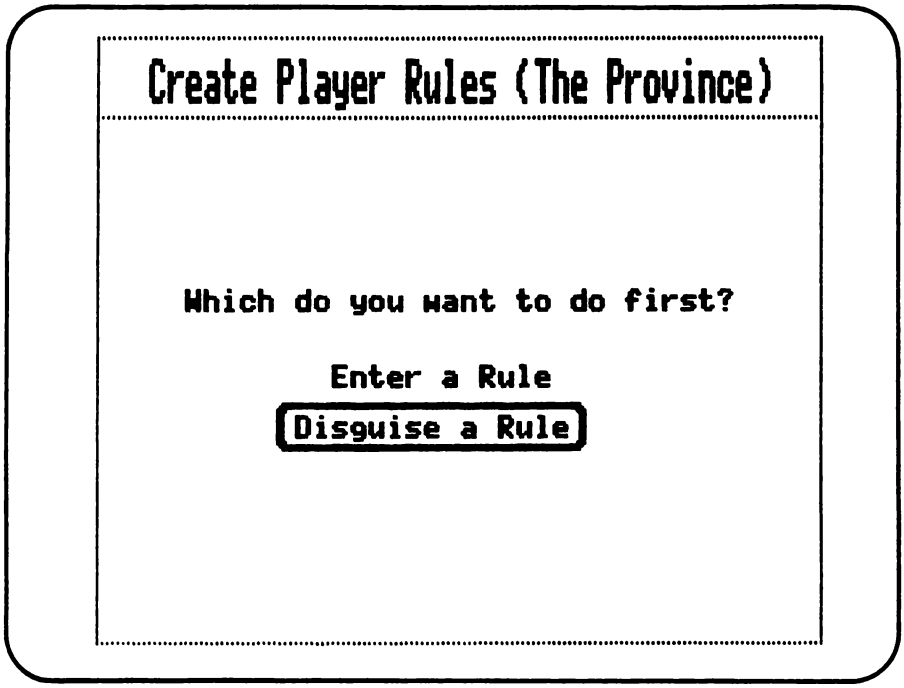

Create Player Rules (The Duchy)
FORMAT: AX+BY+K=C.
In the game, the program will generate A and B randomly.
You should supply X, Y, and K.
Enter number for X (-10 to 10): 2
Enter number for Y (-10 to 10): 1
Enter number for K (-10 to 10): 4_

Here again, a sample of the rule is requested in which the first, second, and third number of the set must be entered.

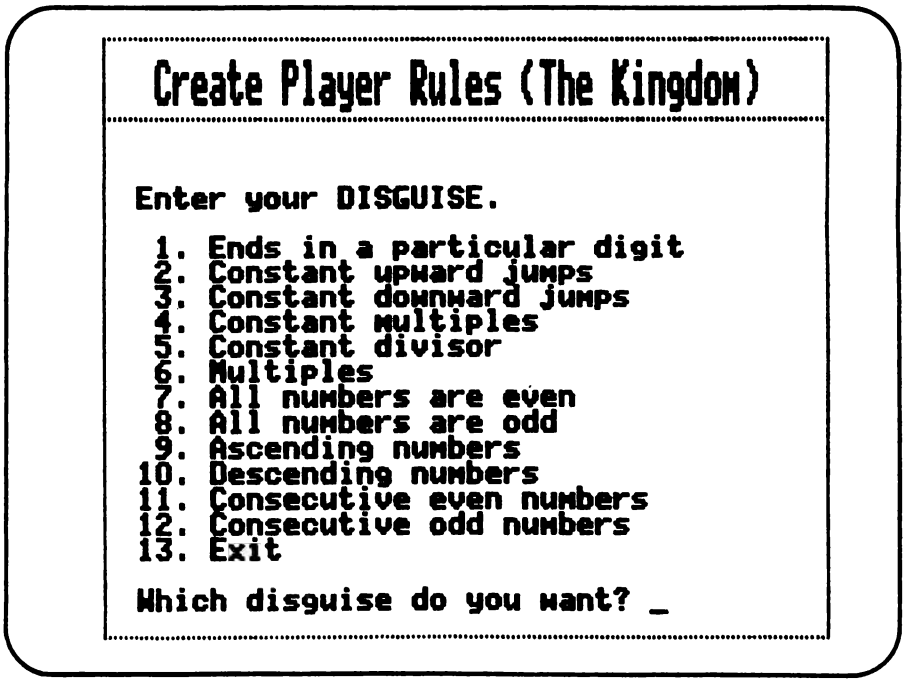


Number trios are then generated, and teachers or players are asked whether they are satisfied with the results displayed.

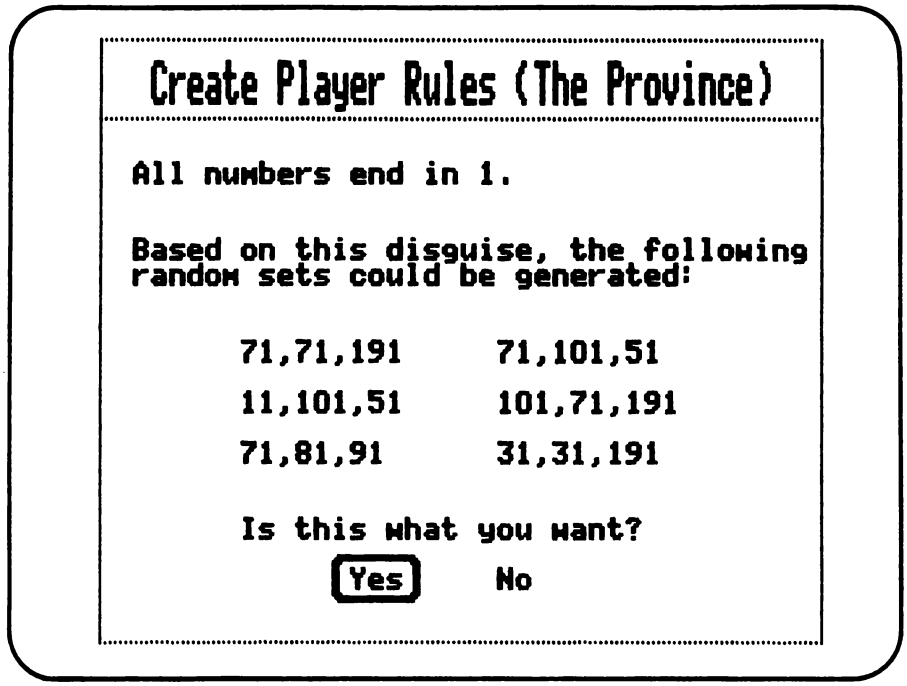
On Levels 3 and 4, teachers or players must create a rule and a disguise for the rule. They may choose the order in which they wish to proceed, as shown below:



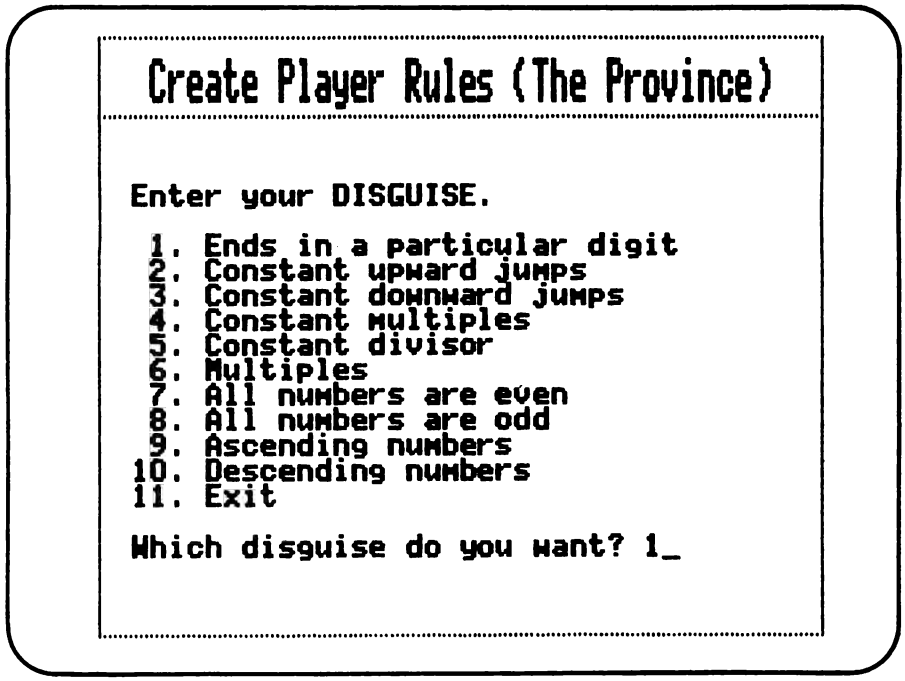
When choosing Disguise a Rule, teachers or players choose a disguise, in this case, "Ends in a particular digit" from a list of available disguises, as shown below:



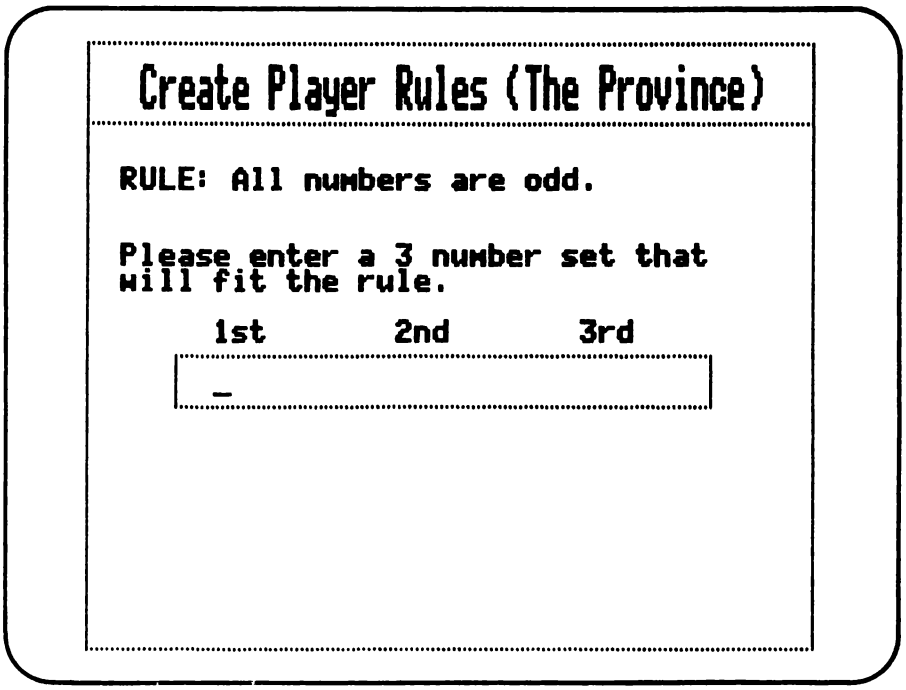
After selecting the particular number needed for the disguise (for example 1), players are asked to provide a number trio which fits the disguise. If the three numbers fit the disguise, players are then shown other number trios, randomly generated as in the example below:



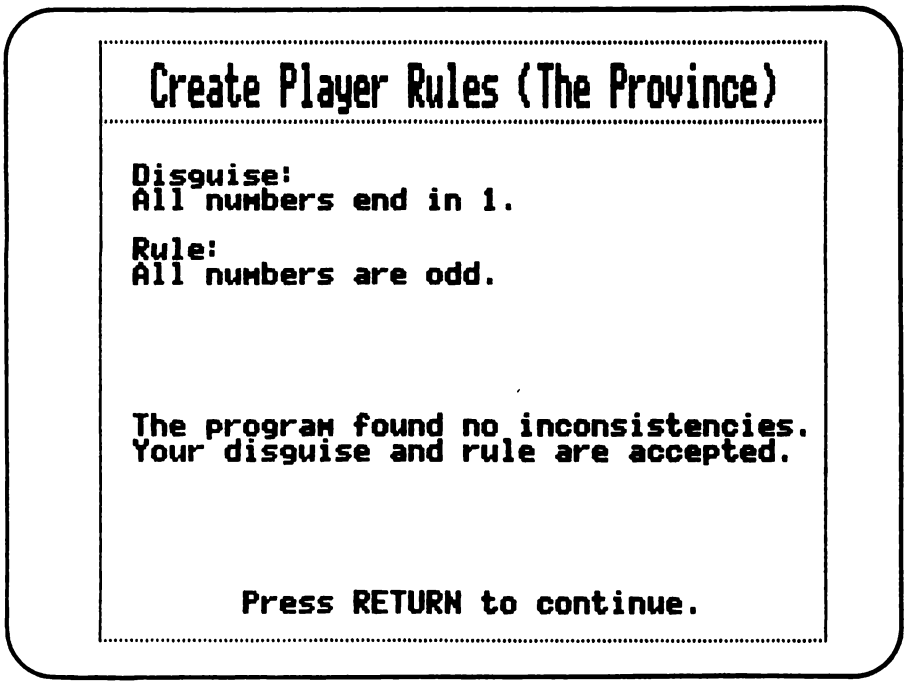
If they have created a disguise first, teachers or players must then enter a rule. They do so by choosing, as in the other levels, from a list of available rules, as shown below:



Suppose a player chooses "All numbers are odd," for the rule (the disguise is still "All numbers end in 1"). A display similar to the one below will then be shown:

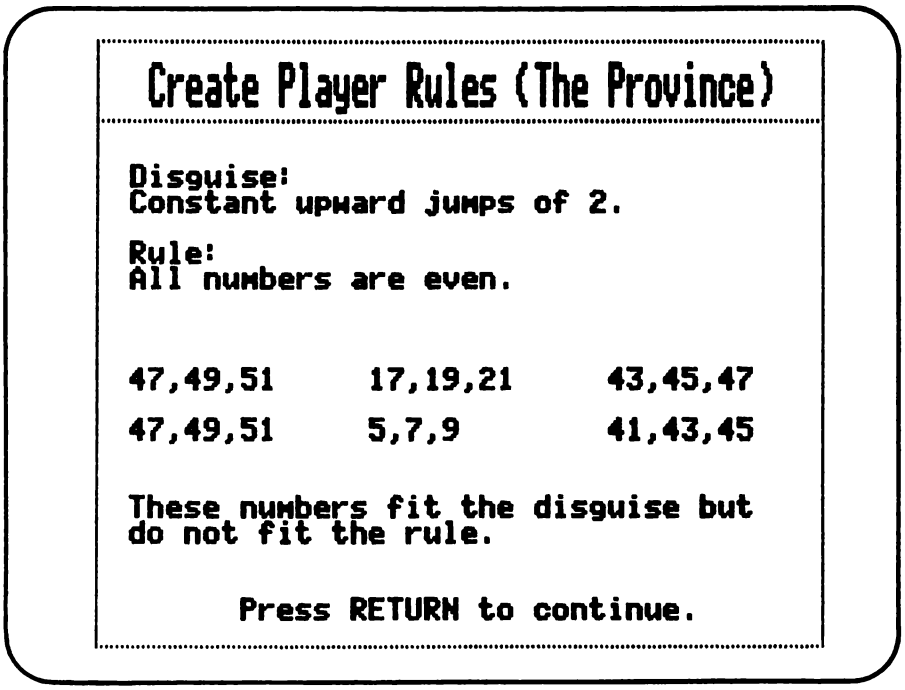


All possible examples of the disguise (in this case 91,111,131, and 11,71,121, and so forth) must fit the rule. A consistency check is then performed on randomly selected examples of the disguise to see if they fit the rule, as shown below:



If no inconsistencies are found, the player is then asked to enter his or her name. The rule and the disguise are then saved on the Data Diskette under the player's name.

If a disguise and a rule fail the consistency check, the player is given a message as follows:

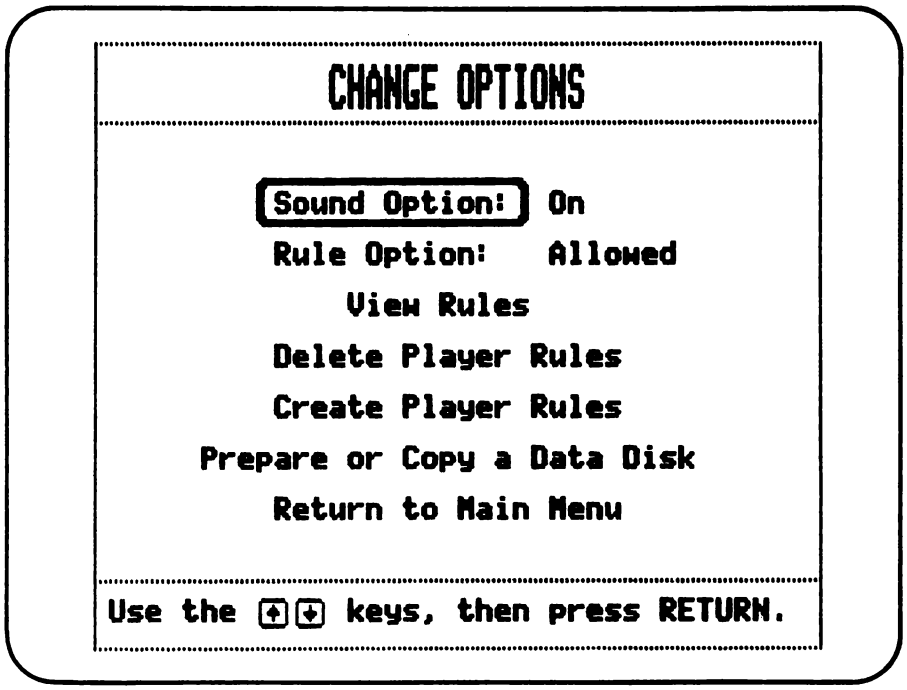

Create Player Rules (The Province)
Disguise:
Constant upward jumps of 2.
Rule:
All numbers are even.
47,49,51 17,19,21 43,45,47
47,49,51 5,7,9 41,43,45
These numbers fit the disguise but do not fit the rule.
Press RETURN to continue.

The player would then be given the opportunity to change either the rule or the disguise or to start over.

After selecting the disguise in Level 4, players may choose to have the rule apply to all the numbers, or at least one of the numbers. If the rule is entered first, the players may also choose to make the rule apply to only one of the numbers. When applying the rule to only one of the numbers, no disguise will be needed.

Change Options

Several change options are provided to enrich the use of The Royal Rules and to give teachers control of the learning situation. By holding down the CONTROL (CTRL) key and T key at the main menu, teachers can make important decisions on behalf of the players, as shown below:



Sound Option

This option allows the teacher to choose whether the sound will be on or off during the program. Answering the question "Do you want sound?" will allow the teacher to turn the sound off or on. The sound will then remain in the mode selected until the Sound Option is used again.

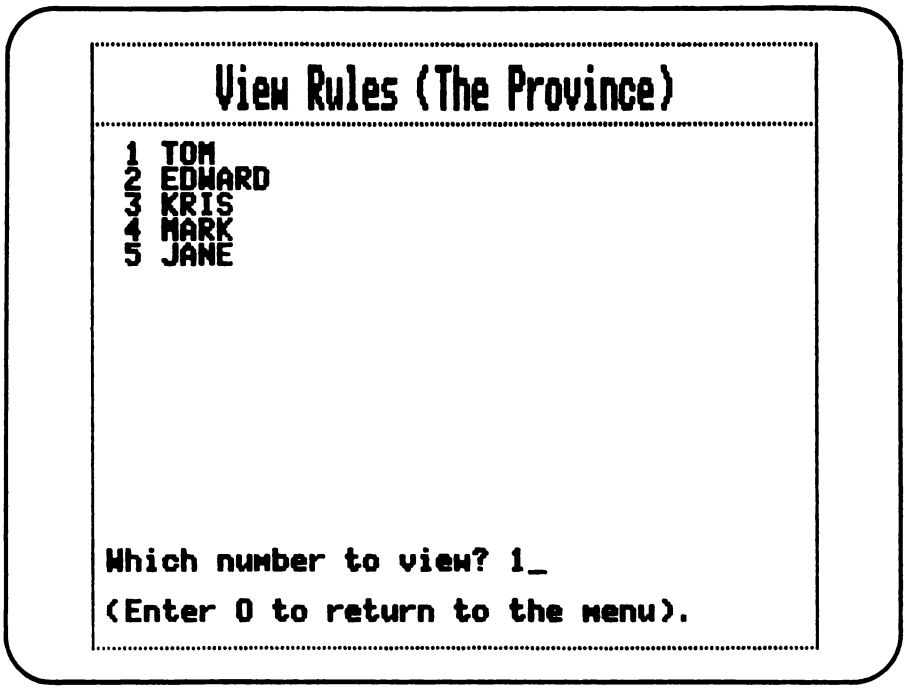
During the game, when the sound is turned on players can then toggle at their discretion between sound on or off by holding down the CONTROL (CTRL) key and pressing S.

Rule Option

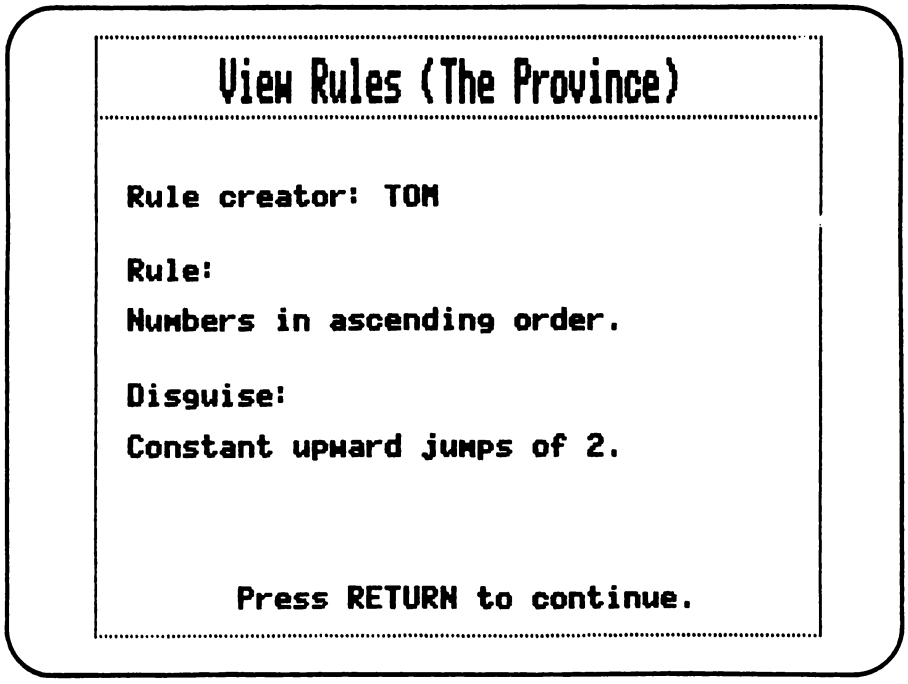
This option allows teachers to turn the Rule Option on or off. When the Rule Option is turned on, players who have successfully completed three quizzes, at any one level, will be given the option of entering their own rules. Since teachers may wish to focus the players' attention on certain types of rules, they can turn the Rule Option off, thus preventing new rules from being added by players. Once the option has been turned off (or on), it will remain in the mode selected until this option is used again.

View Rules

This option allows teachers to view the rules created by the players. Teachers first choose the level (for example: The Province), then the particular rule(s) to be viewed. The rules are listed by the names of the players who entered them. Here's a look at how the players' names are listed for a chosen level (The Province):



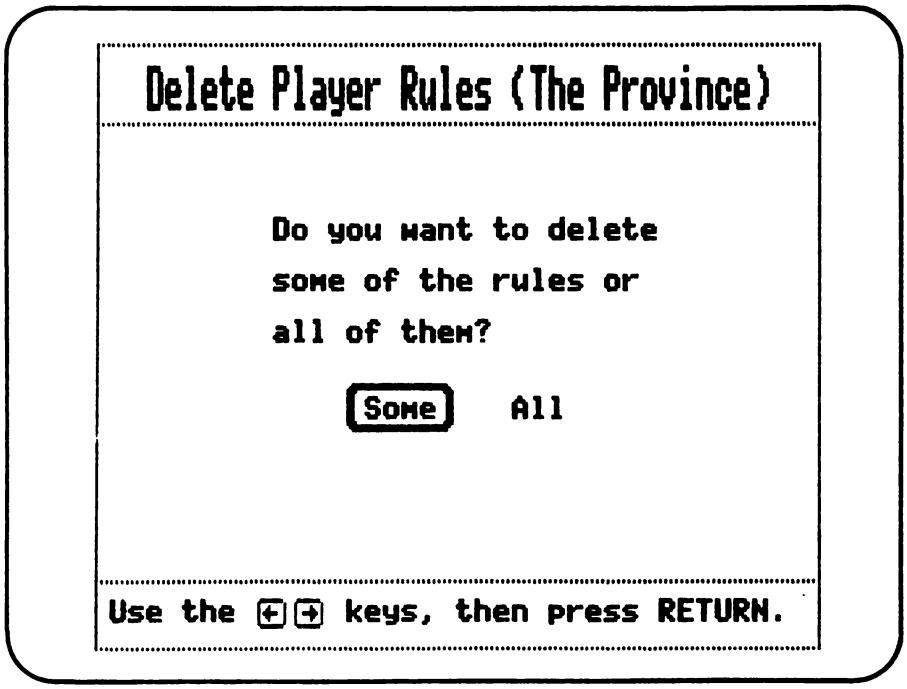
After choosing the name of the player whose rule will be viewed, the teacher is then given information as shown below:



Teachers may get a printout of Player Rules at each of the four levels. To obtain this printout with any type of printer, they need to hold down the CONTROL (CTRL) key and press the P key when asked "Which number to view?" All the Player Rules in that level will be sent to the printer. Before printing begins, the question, "Which slot is your printer card in?" is displayed (on the Apple IIc: "Which port is your printer attached to?"). The printer card is usually in slot 1 (on the Apple IIc, printer attached to port 1).

Delete Player Rules

This option allows teachers to delete some of the Player Rules (because of redundancy), or all of the Player Rules. After choosing the level, teachers are asked the following question:


Delete Player Rules (The Province)
Do you want to delete some of the rules or all of them?
Some
All
Use the ← → keys, then press RETURN.

To delete some of the rules, teachers choose from a list of names under which these rules were entered. If they choose to delete all of the rules, teachers will be given the opportunity to change their mind.

Create Player Rules

Perhaps most important, teachers can add rules of their own--as many as they want--and at any level of the program. (See Creating Rules page 19.)